

UNITED STATES PATENT OFFICE.

GEORGE B. GRANT, OF CAMBRIDGE, MASSACHUSETTS.

IMPROVEMENT IN CALCULATING-MACHINES.

Specification forming part of Letters Patent No. 129,335, dated July 16, 1872.

Specification describing certain Improvements in Calculating-Machines, invented by GEORGE B. GRANT, of Cambridge, county of Middlesex and State of Massachusetts.

My invention relates to certain mechanical devices by which the processes of multiplication and division may be performed without the aid of mental computation. The machine consists of devices by which one number can be added to another any given number of times in succession, for both multiplication and division may be performed by that process. Multiplication is the addition of the multiplicand to itself as many times as there are units in the multiplier. Division is the addition of the complement of the divisor to the dividend till it is reduced to a negative quantity. The quotient is one less than the number of additions made. When one number is to be added to another the figures of one are added to the corresponding figures of the other at one operation and all at once; and a note being made of any carriage that becomes necessary, it is attended to afterward by itself, at another operation.

The machine may be divided into three main divisions or parts—a part on which the multiplicand, divisor, or number to be added is set up; a part on which the number to be added to is set up, upon which the calculations are made, and in multiplication the result appears; and an intermediate part, which receives motion, and adds the number on the first part to that upon the second.

The first part receives the number to be added, and consists mainly of the plate P. This plate is movable in the guides *g* and *g'* in the direction of the length of the machine. It is provided with rows of holes, eleven holes in a row, and each hole, except the highest one, is numbered. The first, third, and alternate odd rows may be designated as positive rows, and are numbered from zero to nine, in order. The second, fourth, and even rows are negative, and are numbered in the reverse order, first from zero to one, and the others from nine to zero. To each row belongs a pin, *p*, which can be fixed in any hole. The place of the holes and pins may be taken by their equivalents, a slot and slide, for the same purpose. The multiplicand is set up in the positive rows—5 3 7, for example, is set up by putting a pin

in hole 7 of the first row, a pin in hole 3 of the third row, and a pin in hole 5 of the fifth row. The divisor is set up in the same manner, but in the negative rows.

It is evident, from the reversion of the numbering of the negative rows, that if the machine uses a number as it is set up in the positive rows it will use the complement of any number as set up in the negative ones, so that the complement of the divisor need not be computed directly. By using two sets of holes we are enabled to set up both a number and its complement at once. If a number is set up on the plate and then it is moved one place to the right or left, each pin will be one place higher or lower than before, and the number will be multiplied or divided by ten.

The second part receives the number to be added to, and consists mainly of the wheels A B C, turning on the fixed arbor D. This arbor supports the piece E, and this piece supports three guides, F G H. The guides are so formed on their inner faces as to keep the wheels in position, and they serve as supports to other mechanism. The number of wheels determines the capacity of the machine. If it contains ten wheels, it is capable of multiplying two numbers together which give a product of not over ten decimal places, and it will divide a number of ten or less places. Each wheel is divided into any convenient number of divisions, and each division into ten spaces. The drawing shows three divisions and thirty spaces. Each space is numbered, and furnished with a nick or tooth. The spaces are numbered from zero to nine, in order. The wheel A represents units, the wheel B tens, and so on. The position K is chosen as the point from which to take all numbers, and the number to be added to is set up by moving the wheels till the proper figures appear at K.

The third main division receives motion and performs the calculations. It consists of the drivers M M M, one driver to each wheel, and so connected that they move between the plate and wheels. Each driver is movable slightly up and down. When down, it is between the teeth of its wheel, and will move it till lifted off by a lifter, L, fixed to the guide G. When up, it is in position to hit the pin projecting